

Claim 71,

Line 2, change "63-70," to --63-66,--.

Claim 72,

Line 2, change "63-70," to --63-66,--.

Claim 73,

Line 2, change "62-72," to --63-66,--.

Claim 74,

Line 2, change "63-72," to --63-66,--.

Claim 75,

Line 5, change "Claims 63-74;" to
--Claims 63-66;--.

REMARKS

Claims 1-84 are pending in the application, with Claims 1-4, 13-16, 26-29, 38-41, 51-54, 63-66 and 76 being independent. Claims 9-12, 21-25, 34-37, 45-50, 59-62 and 71-75 have been amended to correct improper multiple dependencies.

Favorable consideration and early examination on the merits are requested.

Applicants' undersigned attorney may be reached in our Washington, D.C. office by telephone at (202) 530-1010. All correspondence should be directed to our address given below.

Respectfully submitted,


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VERSION WITH MARKINGS TO SHOW CHANGES

MADE TO THE SPECIFICATION

The paragraph starting at page 6, line 9 and ending at page 6 line 13 has been amended as follows:

U.S. Patent No. [5,415,853] 5,415,835 shows a procedure of forming a fine pattern with a dual-beam interference exposure process. With this dual-beam interference exposure process, a pattern of 0.15 micron or less can be produced on a wafer.

The paragraph starting at page 9, line 23 and ending at page 9, line 27 has been amended as follows:

In a fourth form of exposure method according to the present invention, one and the same mask pattern is projected onto a common exposure region in accordance with [bight-field] bright-field oblique illumination and bright-field perpendicular illumination.

The paragraph starting at page 11, line 7 and ending at page 11, line 12 has been amended as follows:

In a fourth form of exposure apparatus according to the present invention, there is an exposure mode in which one and the same mask pattern is projected onto a common exposure region in accordance with [bight-field] bright-field oblique illumination and bright field perpendicular illumination.

VERSION WITH MARKINGS TO SHOW CHANGES MADE TO THE CLAIMS

13. (Amended) An exposure apparatus, [characterized by an exposure mode in which one and the same mask pattern is projected onto a common exposure region in accordance with bright-field illumination, with a constant exposure wavelength, while changing an illumination condition] comprising:

first exposure means for illuminating a predetermined mask pattern with light of a predetermined wavelength under a first illumination condition, to print the same on a predetermined exposure region; and

second exposure means for illuminating the predetermined mask pattern with light of the predetermined wavelength under a second illumination condition, different from the first illumination condition, to print the same on the predetermined exposure region,

wherein exposures by said first and second exposure means are carried out prior to a development process.

14. (Amended) An exposure apparatus, [characterized by an exposure mode in which one and the same mask pattern is projected onto a common exposure region in accordance with bright-field illumination under small σ and large σ] comprising:

first exposure means for illuminating a predetermined mask pattern with a sigma to print the same on a predetermined exposure region; and

second exposure means for illuminating the predetermined mask pattern with a second sigma, different from the first sigma, to print the same on the predetermined exposure region;

wherein exposures by said first and second exposure means are carried out prior to a development process.

15. (Amended) An exposure apparatus, [characterized by an exposure mode in which one and the same mask pattern is projected onto a common exposure region in bright-field illumination, with a small numerical aperture NA and a large numerical aperture NA] comprising:

first exposure means for illumination a predetermined mask pattern with light of a first NA to print the same on a predetermined exposure region; and

second exposure means for illuminating the predetermined mask pattern with light of a second NA, different from the first NA, to print the same on the predetermined exposure region;

wherein exposures by said first and second exposure means are carried out prior to a development process.

16. (Amended) An exposure apparatus, [characterized by an exposure mode in which one and the same mask pattern is projected onto a common exposure region in accordance with bight-field oblique illumination and bright-field perpendicular illumination] comprising:

first exposure means for obliquely illuminating a predetermined mask pattern to print the same on a predetermined exposure region; and

second exposure means for perpendicularly illuminating the predetermined mask pattern to print the same on the predetermined exposure region,

wherein exposures by said first and second exposure means are carried out prior to a development process.

17. (Amended) An apparatus according to any one of Claims [14] 13 - 16 wherein the mask pattern includes an opening pattern with a linewidth not greater than a resolution limit of an exposure apparatus to be used.

20. (Amended) An apparatus according to Claim 17, wherein there is a desired pattern and an auxiliary pattern having a shape different from that of a repetition of the desired pattern, disposed adjacent to the [opening] mask pattern.

23. (Amended) An apparatus according to any one of Claims 13 - 16, wherein [exposures of the exposure region under different illumination conditions are performed sequentially without a development process to the exposure region] the exposure wavelength of said first exposure means and the exposure wavelength of said second exposure means are substantially the same.

24. (Amended) An apparatus according to any one of Claims 13 - 16, wherein exposures of the exposure region under different illumination conditions are

performed simultaneously without [mutual] interference of lights in the different illumination conditions.

25. (Amended) A device manufacturing method, comprising the steps of:
exposing a wafer [to a device] with a mask pattern by use of an exposure apparatus as recited in any one of Claims 13- 16; and
developing the exposed wafer.

38. (Amended) An exposure apparatus[, characterized by an exposure mode in which one and the same mask pattern is projected onto a common exposure region through illumination under small σ and large σ , while changing a spatial frequency passage spectrum of a projection optical system] for illuminating a predetermined mask pattern with an illumination system and for projecting light from the mask pattern onto a predetermined exposure region through a projection system to print the mask pattern on the exposure region, said apparatus comprising:

first exposure means for illuminating the mask pattern under a first illumination condition and for projecting light from the mask pattern to the exposure region at a first spatial frequency passage spectrum of the projection system, so that the exposure region is exposed with the same; and

second exposure means for illuminating the mask pattern under a second illumination condition, different from the first illumination condition, and for projecting light from the mask pattern to the exposure region at a second spatial frequency

passage spectrum of the projection system, different from the first spatial frequency passage spectrum, so that the exposure region is exposed with the same;

wherein exposures by said first and second exposure means are carried out prior to a development process.

39. (Amended) An exposure apparatus[, characterized by an exposure mode in which one and the same mask pattern is projected onto a common exposure region through illumination while changing an illumination condition and a spatial frequency passage spectrum of a projection optical system] for illuminating a predetermined mask pattern with an illumination system and for projecting light from the mask pattern onto a predetermined exposure region through a projection system to print the mask pattern on the exposure region, said apparatus comprising:

first exposure means for illuminating the mask pattern with a first sigma and for projecting light from the mask pattern to the exposure region at a first spatial frequency passage spectrum of the projection system, so that the exposure region is exposed with the same; and

second exposure means for illuminating the mask pattern with a second sigma, different from the first sigma, and for projecting light from the mask pattern to the exposure region at a second spatial frequency passage spectrum of the projection system, different from the first spatial frequency passage spectrum, so that the exposure region is exposed with the same;

wherein exposures by said first and second exposure means are carried out prior to a development process.

40. (Amended) An exposure apparatus[, characterized by an exposure mode in which one and the same mask pattern is projected onto a common exposure region through illumination with a small numerical aperture NA and a large numerical aperture NA, while changing a spatial frequency passage spectrum of a projection optical system] for illuminating a predetermined mask pattern with an illumination system and for projecting light from the mask pattern onto a predetermined exposure region through a projection system to print the mask pattern on the exposure region, said apparatus comprising:

first exposure means for illuminating the mask pattern with a first NA and for projecting light from the mask pattern to the exposure region at a first spatial frequency passage spectrum of the projection system, so that the exposure region is exposed with the same; and

second exposure means for illuminating the mask pattern with a second NA, different from the first NA, and for projecting light from the mask pattern to the exposure region at a second spatial frequency passage spectrum of the projection system, different from the first spatial frequency passage spectrum, so that the exposure region is exposed with the same;

wherein exposures by said first and second exposure means are carried out prior to a development process.

41. (Amended) An exposure apparatus[, characterized by an exposure mode in which one and the same mask pattern is projected onto a common exposure region

through oblique illumination and perpendicular illumination, while changing a spatial frequency passage spectrum of a projection optical system] for illuminating a predetermined mask pattern with an illumination system and for projecting light from the mask pattern onto a predetermined exposure region through a projection system to print the mask pattern on the exposure region, said apparatus comprising:

first exposure means for obliquely illuminating the mask pattern and for projecting light from the mask pattern to the exposure region at a first spatial frequency passage spectrum of the projection system, so that the exposure region is exposed with the same; and

second exposure means for perpendicularly illuminating the mask pattern and for projecting light from the mask pattern to the exposure region at a second spatial frequency passage spectrum of the projection system, different from the first spatial frequency passage spectrum, so that the exposure region is exposed with the same;

wherein exposures by said first and second exposure means are carried out prior to a development process.

42. (Amended) An apparatus according to any one of Claims [39] 38 - 41, wherein the mask pattern includes an opening pattern with a linewidth not greater than a resolution limit of an exposure apparatus to be used.

48. (Amended) An apparatus according to any one of Claims 38 - 41, wherein [exposures of the exposure region 20 under different illumination conditions are performed sequentially without a development process to the exposure region] the

exposure wavelength of said first exposure means and the exposure wavelength of said second exposure means are substantially the same.

49. (Amended) An apparatus according to any one of Claims 38 - 41, wherein exposures of the exposure region under different illumination conditions are performed simultaneously without [mutual] interference of lights different in the different illumination conditions.

50. (Amended) A device manufacturing method, comprising the steps of:
exposing a wafer [to a device] with a mask pattern by use of an exposure apparatus as recited in any one of Claims 38 - 41; and
developing the exposed wafer.

63. (Amended) An exposure apparatus, [characterized by an exposure mode in which one and the same mask pattern having a predetermined pattern with an auxiliary pattern annexed thereto, is projected onto a common exposure region through illumination, while changing an illumination condition] comprising:

first exposure means for illuminating a predetermined mask pattern with light of a predetermined wavelength under a first illumination condition, to print the same on a predetermined exposure region; and

second exposure means for illuminating the mask pattern with light of the predetermined wavelength under a second illumination condition, different from the first illumination condition, to print the same on the predetermined exposure region;

wherein the mask pattern has a desired pattern and an auxiliary pattern having a shape different from that of a repetition of the desired pattern; and
wherein exposures by said first and second exposure means are carried out prior to a development process.

64. (Amended) An exposure apparatus, [characterized by an mode in which one and the same mask pattern having a pattern with an auxiliary pattern annexed thereto, is projected onto a common exposure region through illumination under small σ and a large σ] comprising:

first exposure means for illuminating a predetermined mask pattern with light of a first sigma, to print the same on a predetermined exposure region; and

second exposure means for illuminating the mask pattern with light of a second sigma, different from the first sigma, to print the same on the predetermined exposure region;

wherein the mask pattern has a desired pattern and an auxiliary pattern having a shape different from that of a repetition of the desired pattern; and

wherein exposures by said first and second exposure means are carried out prior to a development process.

65. (Amended) An exposure apparatus,[characterized by an exposure mode in which one and the same mask pattern having a predetermined pattern with an auxiliary pattern annexed thereto, is projected onto a common exposure region through illumination, with a small numerical aperture NA and a large numerical aperture NA] comprising:

first exposure means for illuminating a predetermined mask pattern with light of a first NA, to print the same on a predetermined exposure region; and

second exposure means for illuminating the mask pattern with light of a second NA, different from the first NA, to print the same on the predetermined exposure region;

wherein the mask pattern has a desired pattern and an auxiliary pattern having a shape different from that of a repetition of the desired pattern; and

wherein exposures by said first and second exposure means are carried out prior to a development process.

66. (Amended) An exposure apparatus, [characterized by an exposure mode in which one and the same mask pattern having a predetermined pattern with an auxiliary pattern annexed thereto, is projected onto a common exposure region through oblique illumination and perpendicular illumination] comprising:

first exposure means for obliquely illuminating a predetermined mask pattern, to print the same on a predetermined exposure region; and

second exposure means for perpendicularly illuminating the mask pattern to print the same on the predetermined exposure region;

wherein the mask pattern has a desired pattern and an auxiliary pattern having a shape different from that of a repetition of the desired pattern; and

wherein exposures by said first and second exposure means are carried out prior to a development process.

67. (Amended) An apparatus according to any one of Claims [64] 63 - 66, wherein the mask pattern includes an opening pattern with a linewidth not greater than a resolution limit of an exposure apparatus to be used.

73. (Amended) An apparatus according to any one of Claims 63 - 66, wherein [exposures of the exposure region under different illumination conditions are performed sequentially without a development process to the exposure region] the exposure wavelength of said first exposure means and the exposure wavelength of said second exposure means are substantially the same.

75. (Amended) A device manufacturing method, comprising the steps of:
 exposing a wafer [to a device] with a mask pattern by use of an exposure apparatus as recited in any one of Claims 63 - 66; and
 developing the exposed wafer.

83. (Amended) An exposure apparatus[, characterized by transferring a pattern of a mask onto a photosensitive substrate in accordance with an exposure method as recited in any one of Claims 76- 82] for illuminating a predetermined mask pattern with an illumination system and for projecting light from the mask pattern onto a predetermined exposure region through a projection system to print the mask pattern on the exposure region, said apparatus comprising:

first exposure means for illuminating the mask pattern under a first illumination condition and for projecting light from the mask pattern to the exposure

region at a first spatial frequency passage spectrum of the projection system, so that the exposure region is exposed with the same; and

second exposure means for illuminating the mask pattern under a second illumination condition, different from the first illumination condition, and for projecting light from the mask pattern to the exposure region at a second spatial frequency passage spectrum of the projection system, different from the first spatial frequency passage spectrum, so that the exposure region is exposed with the same,

wherein the mask pattern has a repetition pattern comprising repeatedly disposed basic patterns, being defined by light transmissive portions,

wherein light passed through adjacent basic patterns of the repetition pattern have a mutual optical phase difference of about 180 deg., and

wherein exposures by said first and second exposure means are carried out prior to a development process.